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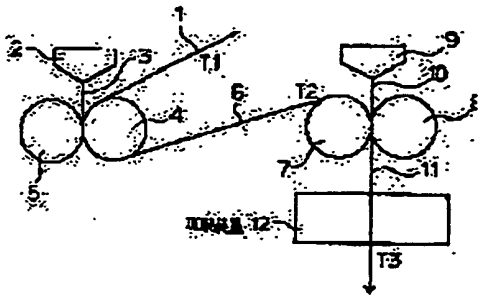
(54) MANUFACTURE OF RESIN COATED METAL SHEET

(57)Abstract:
PURPOSE: To obtain thermoplastic resin coated metal sheet excellent in adhesion, workability, corrosion resistance and external appearance by a method wherein one side of the metal sheet is coated with molten resin supplied from a T-die into the gap between a pressure roll and the preheated metal sheet wrapped round a roll, and then similarly resin is applied on its another side and finally the resultant metal sheet is re-heated.
CONSTITUTION: A pressure roll 5 is brought into contact under pressure with the surface of metal base sheet 1, which is wrapped round a wrapping roll 4 and heated up to the temperature of T1. Under the above-mentioned state, molten thermoplastic resin 3 is supplied from an extruder through a T-die 2 to the interface between the surface of the metal sheet and the pressure roll 5 so as to coat the metal base sheet 1 with the thermoplastic resin. Next, the metal sheet 6 coated on one side is wrapped round a next wrapping roll 7 at the temperature of T2 and, after that, a pressure roll 8 is brought into contact under pressure with the metal sheet 6. Under the above- mentioned state, molten thermoplastic resin 10 is supplied from an extruder through a T-die 9 to the interface between the metal sheet 6 and the pressure roll 8 so as to coat the other side of the metal sheet 6. The metal sheet 11 coated on both sides is re-heated at the temperature of T3 with a heating device 12. Thus, the adhesion of the resin to the metal sheet is enhanced.



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CLAIMS

[Claim(s)]

[Claim 1] The pressure welding of the sticking-by-pressure roll is carried out to the preheated metal plate which wi twisted around the roll with a volume. Flow down the thermoplastics fused from the T die through the extruder in t gap of a sticking-by-pressure roll and a metal plate, and temporary adhesion covering of the thermoplastics is carri out at a metal plate. Subsequently, this resin cladding is twisted around other rolls with a volume so that a resin covering surface may touch a roll side with a volume. The pressure welding of other sticking-by-pressure rolls is carried out from a metal plate side. in the gap of other sticking-by-pressure rolls and a metal plate The manufacture method of the double-sided resin cladding characterized by reheating this double-sided resin cladding with down-stream heating apparatus after flowing down the thermoplastics fused from the T die through the extruder, carrying out temporary adhesion covering of the thermoplastics at other one side of a metal plate and obtaining double-sidec resin cladding.

[Claim 2] The pressure welding of the sticking-by-pressure roll is carried out to the preheated metal plate which wa twisted around the roll with a volume. Flow down the thermoplastics fused from the T die through the extruder in tl gap of a sticking-by-pressure roll and a metal plate, and temporary adhesion covering of the thermoplastics is carrie out at a metal plate. Subsequently, carry out plate leaping, twisting this resin cladding around a sticking-by-pressur roll, and a resin covering surface is reversed. It twists around other rolls with a volume so that a resin covering surface may touch a roll side with a volume. The pressure welding of other sticking-by-pressure rolls is carried out from a metal plate side. in the gap of other sticking-by-pressure rolls and a metal plate The manufacture m thod of the double-sided resin cladding characterized by reheating this double-sided resin cladding with down-stream heatir apparatus after flowing down the thermoplastics fused from the T die through the extruder, carrying out temporary adhesion covering of the thermoplastics at other one side of a metal plate and obtaining double-sided resin cladding

[Claim 3] The claim 1 characterized by reheating at temperature higher than preheat temperature below melting extrusion resin temperature, or a method given in two.

[Claim 4] The claim 1 to which thermoplastics is a polyethylene terephthalate and temperature of the metal plate at the time of preheat temperature covering other one side of the metal plate covered by the resin in one side above 90 degrees C is characterized by reheating temperature being below melting extrusion resin temperature above 140 degrees C at 90 degrees C - 130 degrees C, or a method given in two.

[Claim 5] The claim 1 to which thermoplastics is polypropylene and temperature of the metal plate at the time of preheat temperature covering other one side of the metal plate covered by the resin in one side above 50 degrees C i characterized by reheating temperature being below melting extrusion resin temperature above 100 degrees C at 50 degrees C - 90 degrees C, or a method given in two.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the outstanding adhesion, processability, corrosion resistance, and the manufacture method of the thermoplastics cladding which has appearance.
[0002]
[Description of the Prior Art] Conventionally, the color steel plate which applied and obtained heat-curing acrylic resin coating and the polyester resin paint as a surface treatment metal plate which covered synthetic resin, and the lamination steel plate which laminated the resin film are known.
[0003] These are widely used for the use of construction, the interior material of a bus and a passenger car, the material of a home electrical machinery and apparatus, a furniture furniture, etc. from beautiful color, appearance, and corrosion resistance.
[0004] However, the thing of low molecular weight was used comparatively and the resin used for a paint had a required shell on paint workability, and the fault which macromolecule quantification is not enough, and a flow on metal substrate is not enough, and lacks in endurance also by printing hardening after an application.
[0005] On the other hand, the lamination steel plate which laminated the resin film It is what uses the film by whic extrusion molding was carried out by using as a raw material the resin in which the resin itself carried out macromolecule quantification consistently at petrochemical works, such as vinyl chloride resin, acrylic resin, or a fluororesin. molecular weight is also higher than the resin for paints for whether it being **, therefore compared wi three - five years in a paint application, the endurance of the paint film on a substrate is markedly looked like [abo ten - 20 years], and is a long period of time
[0006] However, the following various troubles exist also in this case.
(1) If thickness of a film is made thin, since phenomena, like a lamination uniform on a substrate becomes difficult and a wrinkling arises on a front face will appear, 50micro thick intensity should usually be made into a limit.
[0007] (2) Since micro irregularity is on a substrate, between the films and substrates which were solidified, it is ea to produce space and the adhesion of a film be inadequate.
[0008] (3) Since it is once fabricated as a film, it is that a use resin has restrictions etc. on film organizati n potenc
[0009] On the other hand, the temperature within the limits of 50-170 degrees C preheats a metal substrate by the heating roller. When the gap of the afterbaking roll and cooling roller is gone on, a melting resin is extruded by the gap of the metal substrate which it preheated by the heating roller, and a cooling roller and this cooling roller is stu by pressure on a metal substrate, while beautiful appearance is acquired It is reported that the surface treatment me plate which was more excellent in adhesion and corrosion resistance is obtained compared with a conventional colc steel plate and a conventional lamination steel plate (Provisional Publication No. No. 203545 [57 to]).
[0010] compared with the metal plate, adhesion with a substrate and corrosion resistance boil this metal plate markedly, and are conventionally excellent Furthermore, since it covered with a direct melting state from a T die, without fabricating on a film, in the conventional film covering, covering to difficult 50micro thick less or equal an 5micro thick intensity of 35 moremicro thick less or equals also of film ** was attained.
[0011] The endurance of a surface treatment metal plate became possible [covering with a thin film] at this invention, although to be able to control thickness according to the grade of required endurance and a price-demanc was desired, since it was greatly influenced by the kind and thickness of thermoplastics.
[0012] Moreover, although it was difficult to be stuck by pressure on a metal plate once being easy to break althou it can consider as a film, and fabricating on a film, since a stiff resin etc. is covered with the state of having flexibility, by this invention, such a stiff resin can also be used for it under melting, for example.
[0013] In addition, since a film forming cycle is skipped, reduction of a price has an advantage.
[0014] Furthermore, the method of co-extruding thermoplastics to both sides of a base material, and manufacturing layered product is also indicated by Provisional Publication No. No. 101451 [55 to].
[0015]

[Problem(s) to be Solved by the Invention] If a [redacted] beforehand heated when [redacted] laminate the thermoplastics extruded from the T die of further others on other one side of the resin cladding which laminated the thermoplastics extruded from the T die on one side of the metal plate which preheated, and to obtair double-sided resin cladding on them, the resin of the obtained one side resin cladding and its temperature of a met plate will be high, and the resin will have softened it.

[0016] And when the resin covered with the 1st T die touched the sticking-by-pressure roll of the 2nd T die, the cr of a roll imprinted on the resin front face, and the problem by which appearance is spoiled occurred.

[0017] As a cause of this crack, when letting line during starting and a metal plate pass, the dirt of the front face o metal plate or a slip of a roll and a metal plate can be considered.

[0018] Although it found out that a crack did not stick when making the preheat temperature of a metal plate low i order that this invention person might solve this problem, adhesion falls conversely.

[0019] Then, while making preheat temperature low, by reheating the double-sided resin cladding which covered a obtained the resin by the 2nd T die, a crack does not stick, but moreover it finds out that adhesion is good, and this invention is completed.

[0020] this invention offers adhesion, processability, corrosion resistance, and the manufacture method of a thermoplastics metal plate excellent in appearance.

[0021]

[Means for Solving the Problem] this invention carries out the pressure welding of the sticking-by-pressure roll to preheated metal plate which was twisted around the roll with (1) volume. Flow down the thermoplastics fused fron the T die through the extruder in the gap of a sticking-by-pressure roll and a metal plate, and temporary adhesion covering of the thermoplastics is carried out at a metal plate. Subsequently, this resin cladding is twisted around tl rolls with a volume so that a resin covering surface may touch a roll side with a volume. The pressure welding of other sticking-by-pressure rolls is carried out from a metal plate side. in the gap of other sticking-by-pressure rolls and a metal plate The manufacture method of the double-sided resin cladding characterized by reheating this doubl sided resin cladding with down-stream heating apparatus after flowing down the thermoplastics fused from the T d through the extruder, carrying out temporary adhesion covering of the thermoplastics at other one side of a metal plate and obtaining double-sided resin cladding, [0022] (2) Carry out the pressure welding of the sticking-by-pressı roll to the preheated metal plate which was twisted around the roll with a volume. Flow down the thermoplastics fused from the T die through the extruder in the gap of a sticking-by-pressure roll and a metal plate, and temporary adhesion covering of the thermoplastics is carried out at a metal plate. Subsequently, carry out plate leaping, twistir this resin cladding around a sticking-by-pressure roll, and a resin covering surface is reversed. It twists around othe rolls with a volume so that a resin covering surface may touch a roll side with a volume. The pressure welding of other sticking-by-pressure rolls is carried out from a metal plate side. in the gap of other sticking-by-pressure rolls and a metal plate The manufacture method of the double-sided resin cladding characterized by reheating this doubl sided resin cladding with down-stream heating apparatus after flowing down the thermoplastics fused from the T di through the extruder, carrying out temporary adhesion covering of the thermoplastics at other one side of a metal plate and obtaining double-sided resin cladding, [0023] (3) The method of (1) and (2) publications which are characterized by reheating at temperature higher than preheat temperature below melting extrusion resin temperatu [0024] (4) The method (1) and given in (2) that thermoplastics is a polyethylene terephthalate and temperature of th metal plate at the time of preheat temperature covering other one side of the metal plate covered by the resin in one side above 90 degrees C is characterized by reheating temperature being below melting extrusion resin temperature above 140 degrees C at 90 degrees C - 130 degrees C, [0025] (5) the method (1) and given in (2) that thermoplastic is polypropylene and temperature of the metal plate at the time of preheat temperature covering other one side of th metal plate covered by the resin in one side above 50 degrees C is characterized by reheating temperature being below melting extrusion resin temperature above 100 degrees C at 50 degrees C - 90 degrees C -- come out

[0026] Hereafter, this invention is explained in detail, referring to a drawing.

[0027] In this invention, a thick steel plate and a thick galvanized steel sheet, the zinc-alloy plating steel plate, a tin plated steel plate, a tin-alloy plating steel plate, an aluminum plating steel plate, an aluminium alloy plating steel plate, or a stainless steel board of board thickness etc. is first used as a metal substrate from the use used for buildin materials, such as a roof, a wall, and a partition, the charge of automobile material, the material of a home electrical and-electric-equipment product, furniture, a can, etc.

[0028] Furthermore, what has an about 0.1-5micro chemical-conversion layer on this is contained.

[0029] In order that a chemical conversion may raise the corrosion resistance of a metal substrate, oxidation resistance, and adhesion, it is performed as surface treatment of a metal plate, and is performed by phosphoric-acid zinc processing, phosphoric-acid iron processing, or the electrolytic chromate treatment.

[0030] Furthermore, after not performing a chemical conversion or performing a chemical conversion, what has an adhesives layer on this is contained.

[redacted]31] An adhesives layer is a layer which applied about several [at least]micro adhesives, in order t[redacted]

adhesion of a metal substrate and thermoplastics.
[0032] As these adhesives, the adhesive thermoplastics which has functional groups, such as a denaturation polyethylene resin, a denaturation epoxy resin, and denaturation vinyl resin, is suitable.
[0033] Adhesion is good for the both sides f a metal and the thermoplastics used for covering, for example, in the case of a polyolefine covering steel plate, a denaturation polyolefine like an ethylene-vinyl acetate copolymerizati resin or an ethylene-acrylic-acid copolymerization resin is suitable for these.
[0034] The thermoplastics used for covering by this invention For example, a polyethylene-terephthalate resin, Polyolefin resin, acrylic resin, polyester resin, polyamide resin, Vinyl chloride resin, a fluororesin, polycarbonate resin, a polystyrene system resin, ABS plastics, a chlorinated-polyether resin, a urethane resin, etc. are typical. to polyolefin resin There are a polymer or copolymers, such as ethylene, a propylene, 1-butene, and 1-pentene. as acrylic resin There are a polymer or copolymers, such as an acrylic acid, a methacrylic acid, an acrylic ester, methacrylic-acid ester, and an acrylamide. to polyester resin There are a polyethylene terephthalate, oil free polyes etc. to polyamide resin There are the so-called Nylon 66, nylon 6, Nylon 610, Nylon 11, etc. to vinyl chloride resir There is a copolymer with vinyl acetate, others, for example, ethylene, etc., and there are a polytetraflouroethylene 3 ***-ized ethylene chloride resin, a 6 ****-ized ethylene propylene resin, ****-ized vinyl resin, ****-ized vinylidene resin, etc. in a fluororesin. [homopolymer]
[0035] Moreover, you may mix and use two or more resins. Moreover, the additive usually used at the time of film creation, for example, a degradation inhibitor, the modifier, the pigment, etc. may be included. Moreover, in case it covers with a melting state, you may add cross linking agents, such as amino resin and an epoxy resin, in the range which does not lose a fluidity.
[0036] These thermoplastics is suitably chosen according to needs, such as weatherability, cold district fitness, thermal resistance, scratch-proof nature, resistance to contamination, chemicals-proof nature, and deep-drawing processability, according to the use of a surface treatment metal plate. For example, a polyolefine is excellent in co resistance, a polyamide is excellent in abrasion resistance, acrylic resin is excellent in resistance to contamination c chemicals-proof nature, and it is excellent [a fluororesin] in weatherability etc.
[0037] The polyethylene-terephthalate resin is especially useful for an acid-proof use.
[0038] Monolayer covering or multilayer covering of a homotypic or a different-species resin is sufficient as a resi In multilayer covering (for example, a multilayer T die), it can carry out, and a glue line can also be prepared between layers.
[0039] At an interlayer thermoplastics in the upper layer for an adhesive resin to a lower layer for example, by the three-layer T die [the steel plate which is applying and preheating adhesives] [the thermoplastics in a melting stat It can extrude in the shape of a film, and the surface treated steel sheet which carried out multilayer covering directl and continuously can be obtained. Or thermoplastics can be obtained in the 1st lower layer and the surfac treated steel sheet which extruded thermoplastics in the shape of a film by the four-layer T die in the 4th best layer at the 3r interlayer, and carried out multilayer covering of the adhesive resin directly and continuously can be obtained for th adhesive resin which is in the steel plate which is preheating at a melting state to the 2nd interlayer.
[0040] A drawing explains a manufacturing process below.
[0041] A metal substrate needs to precede covering a melting resin and it is necessary to preheat it.
[0042] By carrying out a preheating, the fluidity of a resin increases and adhesion improves.
[0043] When, especially as for the time of a low, preheat temperature uses a cooling roller when not performing a preheating or, the adhesion of a resin is not enough and a result which lacks in corrosion resistance is brought.
[0044] Although the temperature of a preheating is so desirable that it is high since the fluidity of a resin increases, since a resin and adhesives will decompose if too high, it is not desirable. Moreover, it is not desirable from a viewpoint of energy saving.
[0045] And since the crack of a roll will imprint on a resin front face and appearance will be spoiled at the time of tl 2nd covering if temperature of a preheating is made high as described above, preheat temperature is taken as the grade which can carry out temporary adhesion of the resin by the 1st T die.
[0046] This temperature changes with resins, for example, in the case of a double-sided polyethylene terephthalate, the case of 90 degrees C or more and double-sided polypropylene, temporary adhesion at 50 degrees C or more is possible for it.
[0047] Drawing 1 and drawing 2 are explanatory drawings having shown the process of this invention, they carry ou the pressure welding of the sticking-by-pressure roll 5 to the front face of the metal substrate 1 which the temperatur T1 which twisted and was twisted around the roll 4 preheated, flow down the thermoplastics 3 fused from T die 2 through the extruder to the interface of the metal substrate front face and sticking-by-pressure roll 5, and * **** thermoplastics to the metal substrate 1.
[0048] Subsequently, a degree twists the obtained one side resin cladding 6 at temperature T2, it twists around a roll 7, the pressure welding of the sticking-by-pressure roll 8 is carried out to a metal plat 6, it flows down the thermoplastics 10 fused from 2nd T die 9 through the extruder to the interface of a metal plate 6 and the sticking-by-

pressure roll 8, a flowing-down resin is *** (ed) to the resin unpainted surface of a metal plate 6, and double-sided resin cladding 11 is obtained.

[0049] In addition, plate leaping of drawing 2 is carried out, twisting one side resin cladding 6 around the sticking-by-pressure roll 5. Moreover, reverse a resin covering surface with the guide roll 13, and it twists so that a resin covering surface may touch the roll 7 side with a volume. The pressure welding of the sticking-by-pressure roll 8 i carried out to a metal plate 6, it flows down the thermoplastics 10 fused from the 2nd T die through the extruder to the interface of a metal plate 6 and the sticking-by-pressure roll 8, a flowing-down resin is * * * (ed) to the resin unpainted surface of a metal plate, and double-sided resin cladding 11 is obtained.

[0050] At this invention, this metal plate 11 is reheated at temperature T3 with heating apparatus 12. Adhesion improves by this reheating.

[0051] As for the metal plate 11 which came out of heating apparatus, cooling winding is performed.

[0052] Even if cooling may perform a water spray for example, after air cooling and it makes it pass through a wat cooled tub, you may let a cooling roller pass.

[0053] The temperature T2 of a metal plate 6 before performing covering by the 2nd T die here When the resin covered with the 1st T die touches the sticking-by-pressure roll of the place of the 2nd T die, in order to prevent th the crack of a roll imprints on a resin front face, and appearance is spoiled, At an elevated temperature, preferably, the 2nd T die, heating cooling required for this temperature is performed, and it adjusts beforehand that what is necessary is just the temperature which can carry out temporary adhesion of the resin.

[0054] It changes with resins by which this temperature T2 was also covered by the 1st T die, and when a resin is a polyethylene terephthalate, 90-130 degrees C is desirable. Moreover, when a resin is polypropylene, 50-90 degrees is desirable.

[0055] Subsequently, in order to improve the adhesion of a resin, when a resin is a polyethylene terephthalate, 140 degrees C or more are desirable [the temperature / the reheating temperature T3 after the 2nd covering has a desirable elevated temperature, and].

[0056] Moreover, when a resin is polypropylene, 100 degrees C or more are desirable.

[0057] However, since disassembly of a covering resin and degradation will take place if the reheating temperature T3 turns into more than melting extrusion resin temperature, it is not desirable.

[0058] It explains concretely with an example below.

[0059]

[Example]

[0060]

[Example 1] After using the lamination metal plate manufacturing installation which used one pair of rolls with an outer diameter of 300mm shown in drawing 1 and drawing 2 and preheating this steel plate, using an electrolysis chromate-treatment steel plate with a thickness of 0.2mm as a metal plate, melting extrusion flowing down of the polyethylene terephthalate (PET) was carried out from the T die through the extruder at the interface with the roll with which the above-mentioned steel plate and the steel plate have not coiled.

[0061] The lamination metal plate manufacturing installation which furthermore used one pair of rolls with a down-stream outer diameter of 300mm was used, and melting extrusion flowing down of the polyethylene terephthalate was carried out from the T die in another field of a metal plate.

[0062] For 280 degrees C and covering thickness, 50micro and line speed are [melting extrusion resin temperature 50mpm(s). The reheated steel plate was rolled round after cooling and drying to ordinary temperature by the water spray.

[0063] Moreover, in PP (polypropylene), it extruded by two-layer [of PP and Denaturation PP], and 280 degrees C 70micro of thickness, and line speed set melting extrusion resin temperature to 50mpm(s).

[0064] The result was shown in the 1st table and the 2nd table.

[0065]

[Table 1]

[0066]
[Table 2]

第１表（ＰＥＴ樹脂でのラミネート）

温度Ｔ１	仮接着	温度Ｔ２	仮接着	表面外観	温度Ｔ３	密着性
７０℃	剥離	７０℃	剥離	外観良好		
８０℃	若干剥離	８０℃	若干剥離	〃		
９０℃	接着良好	９０℃	接着良好	〃		
１００℃	〃	１００℃	〃	〃	１００℃	密着性不良
１１０℃	〃	１１０℃	〃	〃	１１０℃	〃
		１２０℃	〃	〃	１２０℃	〃
		１３０℃	〃	〃	１３０℃	密着性若干不良
		１４０℃	〃	若干斑有	１４０℃	密着性良好
		１５０℃	〃	ハッキリ斑有	１５０℃	〃
					１６０℃	〃
					１６０℃	〃

仮接着性－－－ライン通板中に金属板と樹脂が剥がれるかどうかを目視観察
外観　　－－－ラミネート金属板を目視観察
密着性　－－－１８０° 剥離試験（引張強度：１００mm／ｍｉｎ）

第２表（ＰＰ樹脂でのラミネート）

温度Ｔ１	仮接着	温度Ｔ２	仮接着	表面外観	温度Ｔ３	密着性
３０℃	剥離	３０℃	剥離	外観良好		
４０℃	若干剥離	４０℃	若干剥離	〃		
５０℃	接着良好	５０℃	接着良好	〃		
６０℃	〃	６０℃	〃	〃		
７０℃	〃	７０℃	〃	〃		
		８０℃	〃	〃	８０℃	密着性不良
		９０℃	〃	〃	９０℃	密着性若干不良
		１００℃	〃	若干疵有	１００℃	密着性良好
		１１０℃	〃	ハッキリ疵有	１１０℃	〃
		１２０℃	〃	〃	１２０℃	〃
					１３０℃	〃

仮接着性———ライン通板中に金属板と樹脂が剥がれるかどうかを目視観察
外観　———ラミネート金属板を目視観察
密着性　———１８０° 剥離試験（引張強度：１００mm／min）

[0067]
[Effect of the Invention] By this invention, the double-sided resin covering lamination metal plate excellent in adhesion, processability, corrosion resistance, and appearance was able to be manufactured.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is explanatory drawing of the invention-in-this-application method.
[Drawing 2] It is explanatory drawing of the invention-in-this-application method.
[Description of Notations]
1 Metal Plate
2 T Die
3 Thermoplastics
4 Twist and it is Roll.
5 Sticking-by-Pressure Roll
6 One Side Resin Cladding
7 The 2nd Twists and it is Roll.
8 2nd Sticking-by-Pressure Roll
9 2nd T Die
10 Thermoplastics
11 Double-sided Resin Cladding
12 Heating Apparatus
13 Guide Roll

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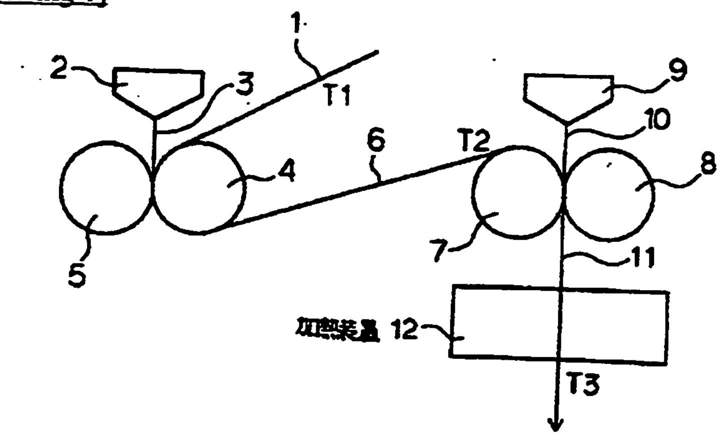
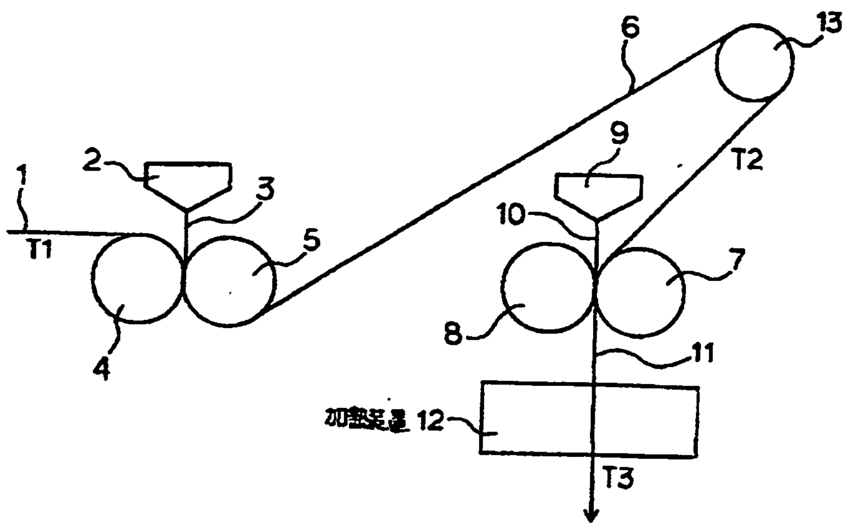
DRAWINGS

[Drawing 1]



[Drawing 2]



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MANUFACTURE OF RESIN COATED METAL SHEET

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[There are no amendments to this patent.]

Abstract

Objective

To provide a method for manufacturing a double-sided thermoplastic resin coated metal sheet that displays superior adhesion, workability, corrosion resistance, and external appearance.

Constitution

A pressure roll is brought into contact under pressure with a preheated metal sheet wrapped on a wrapping roll, resin is temporarily coated on one side of the metal sheet by supplying molten thermoplastic resin into the gap between the pressure roll and the metal sheet from a T-die through an extruder, then resin is temporarily coated on the other side by the same T-die extrusion method, and then the result is reheated.

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Key: 12 Heating device

Claims

1. A method for manufacturing a double-sided resin coated metal sheet characterized by the fact that a pressure roll is brought into contact under pressure with a preheated metal sheet wrapped on a wrapping roll, thermoplastic resin is temporarily coated on the metal sheet by supplying molten thermoplastic resin into the gap between the pressure roll and the metal sheet from a T-die through an extruder, this resin coated metal sheet is wrapped on another wrapping roll so that the resin coated surface is brought into contact with the wrapping roll side, another pressure roll is brought into contact under pressure with the metal sheet side, thermoplastic resin is temporarily coated on the other side of the metal sheet by supplying molten thermoplastic

resin into the gap between this pressure roll and the metal sheet from a T-die through an extruder, and after a double-sided resin coated metal sheet is obtained, this doubled-sided resin coated metal sheet is reheated in a heating device located downstream.

2. A method for manufacturing a double-sided resin coated metal sheet characterized by the fact that a pressure roll is brought into contact under pressure with a preheated metal sheet wrapped on a wrapping roll, thermoplastic resin is temporarily coated on the metal sheet by supplying molten thermoplastic resin into the gap between the pressure roll and the metal sheet from a T-die through an extruder, this resin coated metal sheet is passed through while wrapping on the pressure roll and then is wrapped on another wrapping roll while reversing the resin coated surface so that the resin coated surface is brought into contact with the wrapping roll side, another pressure roll is brought into contact under pressure with the metal sheet side, thermoplastic resin is temporarily coated on the other side of the metal sheet by supplying molten thermoplastic resin into the gap between this pressure roll and the metal sheet from a T-die through an extruder, and after a double-sided resin coated metal sheet is obtained, this doubled-sided resin coated metal sheet is reheated in a heating device located downstream.

3. The method according to Claim 1 or 2 characterized by the fact that the reheating is performed at a temperature that is less than the temperature of the extruded molten resin and higher than the preheating temperature.

4. The method according to Claim 1 or 2 characterized by the fact that the thermoplastic resin is polyethylene terephthalate, the preheating temperature is 90°C or greater, the temperature of the metal sheet when coating the second side of a metal sheet that is coated on one side with resin is 90-130°C, and the reheating temperature is 140°C or greater and less than the temperature of the extruded molten resin.

5. The method according to Claim 1 or 2 characterized by the fact that the thermoplastic resin is polypropylene, the preheating temperature is 50°C or greater, the temperature of the metal plate when coating the second side of a metal plate that is coated on one side with resin is 50-90°C, and the reheating temperature is 100°C or greater and less than the temperature of the extruded molten resin.

Detailed explanation of the invention

[0001]

Industrial application field

The present invention relates to a method for manufacturing a double-sided thermoplastic resin coated metal sheet that displays superior adhesion, workability, corrosion resistance, and external appearance.

[0002]

Prior art

Conventionally, coated steel sheets obtained by coating a thermosetting acrylic resin coating material or a polyester resin coating material or laminated steel sheets laminated with a resin film are known as surface treated metal sheets coated with synthetic resin.

[0003]

These are used widely as interior materials for buildings, buses, passenger cars, materials for home appliances, furniture, etc. due to the beautiful colors, external appearance, and corrosion resistance.

[0004]

However, as the resin used in the coating materials, resins with relatively low molecular weight are used due to the need for workability in the coating process and hence disadvantages exist such as insufficient increase in the molecular weight even when baked and set after being coated, insufficient flow onto the metal base sheet, and lack of durability.

[0005]

On the other hand, in laminated sheets laminated with a resin film, a film that was formed by extrusion molding of a resin wherein the molecular weight was consistently increased at a petrochemical plant such as vinyl chloride resin, acrylic resin, or fluorine-containing resin is used. The molecular weight is higher than for resins used in coating materials and hence the durability of a coated film on a base sheet is much greater at 10-20 years as compared with 3-5 years for a coating material.

[0006]

However, even in this case, there are the various problems described below.

(1) If the film is thin, uniform lamination on a base sheet becomes difficult and phenomena such as creation of creases on the surface, etc. appear and hence the thickness is normally limited to about 50 μm.

[0007]

(2) There are irregularities of micro order on the base sheet. Therefore, there is a tendency for gaps to be created between the solidified film and the base sheet and adhesion of the film is insufficient.

[0008]

(3) It is formed temporarily as a film and hence there is a restriction in the resin used in relation to the formability of the resin into a film.

[0009]

On the contrary, it has been reported that by preheating a metal base sheet with a hot roll at a temperature within a range of 50-170°C, passing the metal base sheet through a gap between the hot roll and a cold roll, and extruding a molten resin into the gap between the cold roll and the metal base sheet that was preheated with the hot roll with said resin being brought into contact under pressure with the metal base sheet by said cold roll, a beautiful external appearance is obtained along with obtaining a surface treated metal sheet of superior adhesion and corrosion resistance in comparison with conventional coated steel sheets or laminated steel sheets (Japanese Kokai Patent Application Number Sho 57[1982]-203545).

[0010]

This metal sheet displays superior adhesion to the base sheet and corrosion resistance when compared with conventional metal sheets. Furthermore, coating is performed directly in the molten state from a T-die without forming a film hence coating a film with a thickness of 50 μm or less which was difficult in conventional film coating, and even a thickness of 35 μm or less to about 5 μm has become possible.

[0011]

The durability of the surface treated metal sheet is greatly influenced by the film thickness and the type of thermoplastic resin. Therefore, there was a desire to be able to control the film thickness according to needs in relation to cost and the degree of durability required. With the present invention, coating a thin film has been enabled.

[0012]

Also, though hard resins can be formed into a film, a tendency to break exists and it is difficult to bring such a film into contact under pressure with a metal sheet after it has been formed temporarily into a film. However, with this invention, using a hard resin is possible since the coating is performed in the flexible molten state.

[0013]

In addition, the film formation process is omitted so there is the advantage of the cost being reduced.

[0014]

Furthermore, a method for manufacturing a laminate by co-extruding a thermoplastic resin on both sides of a base sheet has been disclosed in Japanese Kokai Patent Application Number Sho 55[1980]-10145.

[0015]

Problems to be solved by the invention

When a method for obtaining a double-sided resin coated metal sheet was examined in regard to the present invention by laminating the other side of a resin coated metal sheet, which had been obtained by laminating one side of a preheated metal sheet with a thermoplastic resin extruded from a T-die, with a thermoplastic resin extruded from another T-die, it was found that when the metal sheet is preheated, the temperatures of the metal sheet and the resin in the single sided resin coated metal sheet that had been obtained were high and the resin softened.

[0016]

Also, when the resin coated with the first T-die contacts the pressure roll in the second T-die, a problem is created in that the external appearance becomes inferior due to flaws on the roll being transferred onto the resin surface.

[0017]

As the origin of these flaws, contamination on the surface of the metal sheet or slip of the roll or metal sheet when passing the metal sheet through at the start of the line can be considered.

[0018]

In order to solve this problem, the inventors of the present invention found that flaws are not created if the preheating temperature of the metal sheet is decreased. However, the adhesion decreases.

[0019]

Therefore, by decreasing the preheating temperature and reheating the double-sided resin coated metal sheet obtained by coating resin in the second T-die, the inventors found that flaws are not created, and moreover the adhesion is favorable and thus the inventors achieved the present invention.

[0020]

The present invention provides a method for manufacturing a double-sided thermoplastic resin coated metal sheet that displays superior adhesion, workability, corrosion resistance, and external appearance.

[0021]

Means to solve the problems

The present invention is (1) a method for manufacturing a double-sided resin coated metal sheet characterized by the fact that a pressure roll is brought into contact under pressure with a preheated metal sheet wrapped on a wrapping roll, thermoplastic resin is temporarily coated on the metal sheet by supplying molten thermoplastic resin into the gap between the pressure roll and the metal sheet from a T-die through an extruder, this resin coated metal sheet is wrapped on another wrapping roll so that the resin coated surface is brought into contact with the wrapping roll side, another pressure roll is brought into contact under pressure with the metal sheet side, thermoplastic resin is temporarily coated on the other side of the metal sheet by supplying molten thermoplastic resin into the gap between this pressure roll and the metal sheet from a T-die through an extruder, and after a double-sided resin coated metal sheet is obtained, this doubled-sided resin coated metal sheet is reheated in a heating device located downstream,

[0022]

(2) a method for manufacturing a double-sided resin coated metal sheet characterized by the fact that a pressure roll is brought into contact under pressure with a preheated metal sheet wrapped on a wrapping roll, thermoplastic resin is temporarily coated on the metal sheet by supplying molten thermoplastic resin into the gap between the pressure roll and the metal sheet from a T-die through an extruder, this resin coated metal sheet is passed through while wrapping on the pressure roll and then is wrapped on another wrapping roll while reversing the resin coated surface so that the resin coated surface is brought into contact with the wrapping roll side, another pressure roll is brought into contact under pressure with the metal sheet side, thermoplastic resin is temporarily coated on the other side of the metal sheet by supplying molten thermoplastic resin into the gap between this pressure roll and the metal sheet from a T-die through an extruder, and after a double-sided resin coated metal sheet is obtained, this doubled-sided resin coated metal sheet is reheated in a heating device located downstream,

[0023]

(3) the method according to (1) or (2) characterized by the fact that the reheating is performed at a temperature that is less than the temperature of the extruded molten resin and higher than the preheating temperature,

[0024]

(4) the method according to (1) or (2) characterized by the fact that the thermoplastic resin is polyethylene terephthalate, the preheating temperature is 90°C or greater, the temperature of the metal sheet when coating the second side of a metal sheet that is coated on one side with a resin is 90-130°C, and the reheating temperature is 140°C or greater and less than the temperature of the extruded molten resin, and

[0025]

(5) the method according to (1) or (2) characterized by the fact that the thermoplastic resin is polypropylene, the preheating temperature is 50°C or greater, the temperature of the metal plate when coating the second side of a metal plate that is coated on one side with a resin is 50-90°C, and the reheating temperature is 100°C or greater and less than the temperature of the extruded molten resin.

[0026]

Below, the present invention will be described in detail while referring to figures.

[0027]

In the present invention, firstly, thick steel sheets, zinc plated steel sheets, zinc alloy plated steel sheets, tin plated steel sheets, tin alloy plated steel sheets, aluminum plated steel sheets, aluminum alloy plated steel sheets, stainless steel sheets, etc. used as construction materials for roofs, walls, partitions, etc., materials for automobiles, materials for home appliances, furniture, cans, etc. are used as the metal base sheet.

[0028]

Furthermore, these metal base sheets provided with a chemical conversion treatment layer of about 0.1-5 μm are also included.

[0029]

Chemical conversion treatment is performed as a surface treatment of metal sheets in order to enhance corrosion resistance, oxidation resistance, and adhesion to the metal base sheet

and is performed, for example, according to a zinc phosphate treatment, iron phosphate treatment, or electrolytic chromate treatment.

[0030]

Furthermore, metal sheets provided with an adhesive layer but without a chemical conversion treatment or after performing a chemical conversion treatment are also included.

[0031]

The adhesive layer is a layer composed from coating at least a few μm of an adhesive in order to enhance adhesion between the metal base sheet and the thermoplastic resin.

[0032]

As this adhesive, thermoplastic adhesive resins that have a functional group such as modified polyethylene resin, modified epoxy resin, modified vinyl resin, etc. are favorable.

[0033]

These have favorable adhesion to both the metal and the thermoplastic resin used to coat the metal and for example, for a polyolefin coated steel sheet, a modified polyolefin such as ethylene – vinyl acetate copolymer resin or ethylene – acrylic acid copolymer resin is favorable.

[0034]

As the thermoplastic resin used for coating in the present invention, polyethylene terephthalate resin, polyolefin resin, acrylic resin, polyester resin, polyamide resin, vinyl chloride resin, fluorine-containing resin, polycarbonate resin, polystyrene resin, ABS resin, chlorinated polyester resin, urethane resin, etc., are representative. As polyolefin resin, there are polymers and copolymers of ethylene, propylene, 1-butene, 1-pentene, etc. As acrylic resin, there are polymers and copolymers of acrylic acid, methacrylic acid, acrylic ester, methacrylic ester, acrylic amide, etc. As polyester resin, there are polyethylene terephthalate, oil free polyester, etc. As polyamide resin, there are so-called nylon 66, nylon 6, nylon 610, nylon 11, etc. As vinyl chloride resin, there are copolymers of, for example, ethylene or vinyl acetate in addition to homopolymers. As fluorine-containing resin, there are tetrafluoroethylene resin, trifluoroethylene chloride resin, hexafluoroethylene propylene resin, polyvinyl fluoride resin, polyvinylidene resin, etc.

[0035]

Also, it is possible to mix two or more resins. Additives commonly used in forming films, for example, a deterioration inhibitor, modifier, pigment, etc. can be included. Also, when coating in the molten state, it is possible to add a cross-linking agent such as amino resin, epoxy resin, etc. in a range wherein fluidity is not decreased.

[0036]

These thermoplastic resins are appropriately selected according to necessity such as weatherability, cold zone suitability, heat resistance, scratch resistance, contamination resistance, chemical resistance, deep drawing workability, etc. For example, polyolefin displays superior cold resistance, polyamide displays superior wear resistance, acrylic resin displays superior contamination resistance and chemical resistance, and fluorine-containing resin displays superior weatherability.

[0037]

Polyethylene terephthalate resin is effective for oxidation resistance in particular.

[0038]

These resins can be a single layer coating or can be a multi-layer coating of the same kind or different kinds of resins. In the case of a multi-layer coating, it can be performed with, for example, a multi-layer T-die with an adhesive layer provided between the layers.

[0039]

For example, it is possible to obtain a surface treated steel sheet coated directly and continuously with multiple layers by extruding in the form of a film from a triple layer T-die a thermoplastic resin in the molten state as the bottom layer, an adhesive resin as the middle layer, and a thermoplastic resin as the top layer on a steel sheet that has been coated with an adhesive and preheated or it is possible to obtain a surface treated steel sheet coated directly and continuously with multiple layers by extruding from a four layer T-die an adhesive resin in a molten state as a he first bottom layer, a thermoplastic resin as a second middle layer, an adhesive resin as the third middle layer, and a thermoplastic resin as a fourth upper most layer on a preheated steel sheet.

[0040]

Next, the manufacturing process will be described according to figures.

[0041]

The metal base sheet needs to be preheated before coating the molten resin.

[0042]

By preheating, the fluidity of the resin increases and the adhesion improves.

[0043]

If preheating is not performed or if the preheating temperature is low, in particular, when using a cold roll, the adhesion of the resin is not sufficient and the corrosion resistance becomes inferior.

[0044]

As the preheating temperature increases, the fluidity of the resin increases and this is favorable. However, if it is too high, the resin and the adhesive decompose, and this is not favorable. Also, this is not favorable from the standpoint of energy savings.

[0045]

Moreover, if the preheating temperature is high, flaws on the roll are transferred onto the resin surface during the second coating as was described above and the external appearance becomes unfavorable, hence the preheating temperature should be a temperature such that the resin can be temporarily adhered in the first T-die.

[0046]

This temperature differs according to the resin and for example, in the case of double-sided polyethylene terephthalate, temporary adhesion is possible at 90°C or greater and in the case of double-sided polypropylene, 50°C or higher.

[0047]

Figure 1 and Figure 2 are explanatory drawings showing processes in the present invention. Process roll (5) is brought into contact under pressure with the surface of metal base sheet (1) preheated to temperature (T1) and wrapped on wrapping roll (4), molten thermoplastic resin (3) is supplied from T-die (2) to the interface between the metal base sheet surface and pressure roll (5) through an extruder, and thermoplastic resin is coated on metal base sheet (1).

[0048]

Next, single-sided resin coated metal sheet (6) that was obtained is wrapped at temperature (T2) on wrapping roll (7), pressure roll (8) is brought into contact under pressure with metal sheet (6), molten thermoplastic resin (10) is supplied from second T-die (9) to the interface between metal sheet (6) and pressure roll (8) through an extruder, the supplied resin is coated on the uncoated side of the metal sheet, and double-sided resin coated metal sheet (11) is obtained.

[0049]

In Figure 2, single-sided resin coated metal sheet (6) is passed through while being wrap on pressure roll (5) and the resin coated surface is reversed in guide roll (13) so that the resin coated surface is wrapped by contacting the wrapping roll (7) side, pressure roll (8) is brought into contact under pressure with metal sheet (6), molten thermoplastic resin (10) is supplied from the second T-die to the interface between metal sheet (6) and pressure roll (8) through an extruder, the supplied resin is coated on the uncoated side of the metal sheet, and a double-sided resin coated metal sheet (11) is obtained.

[0050]

In the present invention, metal sheet (11) is reheated at temperature (T3) with heating device (12). The adhesion improves with this reheating.

[0051]

Metal sheet (11) that exits the heating device is cooled and wound.

[0052]

Cooling can be performed by spraying of water after being air cooled or by passing through a cold water bath or a cold roll.

[0053]

Here, temperature (T2) of metal sheet (6) before coating of the second T-die should not be too high in order to prevent flaws on the roll from being transferred onto the resin surface when the resin coated the first T-die is brought into contact with the pressure roll at the second T-die and to prevent the external appearance from becoming inferior, and the temperature should be sufficient to temporarily adhere the resin in the second T-die. For this, heating and cooling necessary to adjust the temperature is preformed in advance.

[0054]

This temperature (T2) also differs according to the resin coated in the first T-die and if the resin is polyethylene terephthalate, 90-130°C is favorable. If the resin is polypropylene, 50-90°C is favorable.

[0055]

Next, it is preferable for reheating temperature (T3) after the second coating to be high in order to enhance the adhesion of the resin and if the resin is polyethylene terephthalate, 140°C or greater is favorable.

[0056]

If the resin is polypropylene, 100°C or greater is favorable.

[0057]

However, if the reheating temperature (T3) is greater than the temperature of the extruded molten resin, decomposition and deterioration of the coated resin occurs, hence this is not favorable.

[0058]

Below, a concrete explanation will be given with an application example.

[0059]

Application example

[0060]

Application Example 1

Using a laminated metal sheet manufacturing apparatus with a pair of rolls shown in Figures 1 and 2 having a major diameter of 300 mm and using an electrolytic chromic acid treated steel sheet having a thickness of 0.2 mm as the metal sheet, polyethylene terephthalate (PET) was melted, extruded, and supplied to the interface between the aforementioned steel sheet and a roll not wrapped with a steel sheet through an extruder with a T-die after preheating the steel sheet.

[0061]

Furthermore, using a laminated metal sheet manufacturing apparatus with a pair of rolls having a major diameter of 300 mm, polyethylene terephthalate was melted, extruded, and supplied to the other surface of the metal sheet from a T-die.

[0062]

The temperature of the extruded molten resin was 280°C, the coat thickness was 50 μm, and the line speed was 50 mpm. The reheated steel sheet was cooled to ambient temperature by spraying with water, dried, then wound.

[0063]

Also, in the case of PP (polypropylene), extrusion was performed in two layers of PP and modified PP, the temperature of the extruded molten resin was 280°C, the film thickness was 70 μm, and the line speed was 50 mpm.

[0064]

The results are shown in Table 1 and Table 2.

[0065]

Table 1 (laminated with PET resin)

Temporary adhesion --- visual observation on whether the metal sheet and the resin separate when passing the sheet through the line

External appearance --- visual observation of the laminated metal sheet
Adhesion --- 180° adhesion test (tensile strength: 100 mm/min)

Key
1 Temperature T1
2 Temporary adhesion
3 Temperature T2
4 Exterior surface appearance
5 Temperature T3
6 Adhesion
7 Separation
8 Slight separation
9 Adhesion is favorable
10 External appearance is favorable
11 Slight flaws
12 Clear flaws
13 Adhesion is defective
14 Adhesion is somewhat defective

[0066]

Table 2 (laminated with PP resin)

Temporary adhesion --- visual observation on whether the metal sheet and the resin separate when passing the sheet through the line
External appearance --- visual observation of the laminated metal sheet
Adhesion --- 180° adhesion test (tensile strength: 100 mm/min)

Key:
1 Temperature T1
2 Temporary adhesion

3	Temperature T2
4	Exterior surface appearance
5	Temperature T3
6	Adhesion
7	Separation
8	Slight separation
9	Adhesion is favorable
10	External appearance is favorable
11	Slight flaws
12	Clear flaws
13	Adhesion is defective
14	Adhesion is somewhat defective

[0067]

Effect of the invention

It was possible to manufacture a double-sided thermoplastic resin coated metal sheet that displays superior adhesion, workability, corrosion resistance, and external appearance with the present invention.

Detailed description of the figures

Figure 1 is an explanatory drawing of a method in the present invention.

Figure 2 is an explanatory drawing of a method in the present invention.

Explanation of symbols

(1)...metal sheet, (2)...T-die, (3)...thermoplastic resin, (4)...wrapping roll, (5)...pressure roll, (6)...single sided resin coated metal sheet, (7)...second wrapping roll, (8)...second pressure roll, (9)...second T-die, (10)...thermoplastic resin, (11)...double-sided resin coated metal sheet, (12)...heating device, (13)...guide roll.

Figure 1

Key: 12 Heating device

Figure 2

Key: 12 Heating device